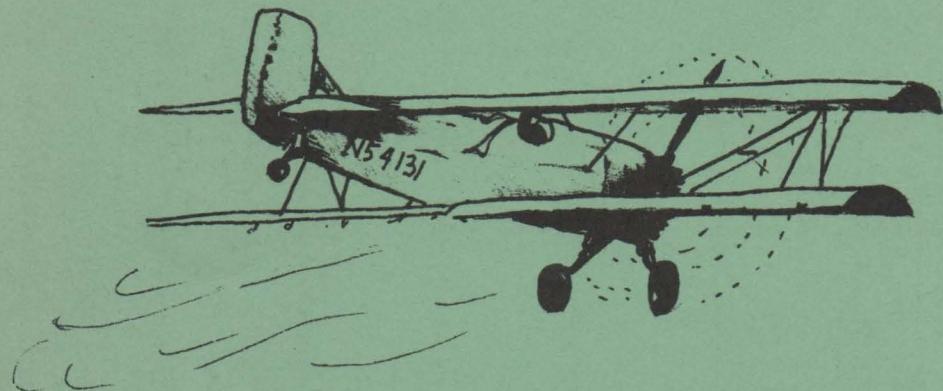


Insecticide Use

in the NATIONAL FORESTS

of the LAKE STATES:

A HISTORY



USDA, FOREST SERVICE, NORTHEASTERN AREA

STATE & PRIVATE FORESTRY, FOREST PEST MANAGEMENT,

ST. PAUL FIELD OFFICE

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INSECTICIDE USE in the NATIONAL FORESTS

of the LAKE STATES: A HISTORY

Richard F. Fowler

ABSTRACT

This report covers recorded insecticide usage in the eight National Forests in the Lake States: Minnesota, Wisconsin, and Michigan.

Insecticides have been applied to about 5.3 percent of the 6,877,899 acres of federal ownership. Lead arsenate was used most frequently in the early years of insect control, 1934-1947, giving way to DDT in the period, 1945-1964. Malathion has been the major substitute for DDT since 1964 when the use of DDT was discontinued in the forest insect suppression programs of the Lake States national forests. Other chemicals have been used in limited amounts for experimental treatments and for control of certain insect species not adequately controlled by one of the above mentioned chemicals.

Chronologically arranged tables listing the target insect species and insecticides used are presented for each forest. Tables for each target insect on each forest are also included and arranged by ranger district.

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CHIPPEWA NATIONAL FOREST

SUPERIOR NATIONAL FOREST

CHEQUAMEGON NATIONAL FOREST

NICOLET NATIONAL FOREST

OTTAWA NATIONAL FOREST

HIAWATHA NATIONAL FOREST

HURON NATIONAL FOREST

MANISTEE NATIONAL FOREST

INTRODUCTION

The current widespread interest in the environment has generated increased interest in past actions which could affect the ecological balance in an area. One of the major interests expressed by the public has been the use of chemicals for control of forest insects. A history of treated insect outbreaks by year(s) of occurrence and location is of interest to the land managers and researchers. This report, based on available data, fills the need for a historical record of insecticide use on the national forests of the Lake States for the control of insect species affecting plantations and natural forest stands from 1934-1971. Insecticide applications in forest tree nurseries, for control of nuisance insects in recreational areas, around building sites, and for so-called household uses are excluded.

The eight National Forests in the Lake States are shown with their respective ranger districts in Figure 1. There are 11,099,279 acres within the boundaries of these forests. Of these, 6,877,899 acres are under federal ownership (Table 1), and the remaining acreage is owned by state and local governments, industry and private individuals. This report deals only with the federally owned

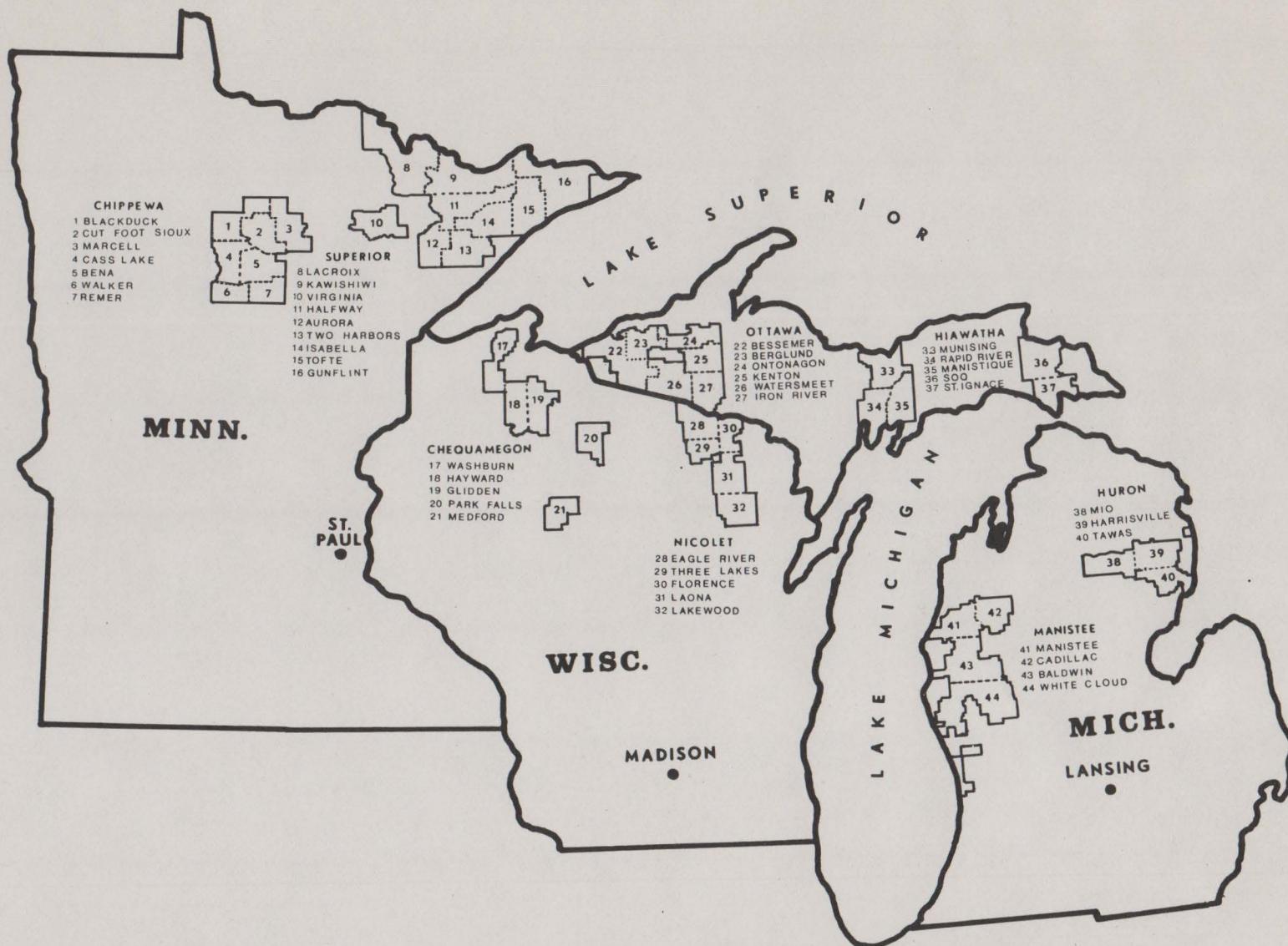


Figure 1.--Lake States national forests by ranger districts--1971.

acreage.

The national forests have provided sites for research, field tests and demonstrations. These experiments and tests using insecticides have usually been conducted to determine the effectiveness of a specific chemical in controlling a target insect species.

Table 1.--Gross and federally-owned Lake States national forests acreages and acres treated with insecticides, 1934-1971.

National Forest	State located	Year established ^a	Acres ^b		Federal acres treated ^c			
			Gross	Federal	Project	Experiment	Total	Percent
Chippewa	Minn.	1923	1,314,322	649,978	26,990+	180	27,170+	4.2+
Superior	Minn.	1909	3,022,657	2,055,018	84,936	570+	85,506+	4.2+
Chequamegon	Wisc.	1936	1,030,993	839,055	44,928+	1,000	45,928+	5.5+
Nicolet	Wisc.	1933	942,008	650,346	53,666+	2,425	56,091+	8.6+
Ottawa	Mich.	1931	1,522,540	915,377	11,989	312	12,301	1.3
Hiawatha	Mich.	1909 ^d	1,260,411	861,084	46,662	15	46,677	5.4
Huron	Mich.	1909	691,444	418,844	10,433	347	10,780	2.6
Manistee	Mich.	1938	1,314,904	488,197	79,530+	3,610	83,140+	17.0+
Total			11,099,279	6,877,899	359,134+	8,459+	367,593+	5.3+

^aSome forests existed earlier as purchase units; this is proclamation date as a National Forest.

^bForest acreages as of June 30, 1972.

^cThe plus (+) sign represents incompletely documented additional treated acreage.

^dEast Unit proclaimed Marquette N.F. in 1909; West Unit proclaimed Hiawatha N.F. in 1931. The Forests were combined in 1964.

HISTORY OF TREATMENT

A total of 367,593+ acres of the Lake States national forests have been sprayed between 1934 and 1971 (Table 1). Of this, 359,134+ acres were sprayed in suppression projects and 8,459+ acres, about 2 percent, were in experiments. If each acre of treated land had received only one application of insecticide during this 38 year period, then 5.3+ percent of the federally-owned land would have received treatment. However, some areas have been treated more than once; therefore, the percentage of treated lands is actually less than shown in Table 1. Subsequent treatment(s) on the same acreage have not necessarily been directed against the same insect species.

The earliest use of chemicals for insect control in the Lake States national forests, for which documents are available, occurred in 1934 in the Manistee National Forest, Michigan, for redheaded pine sawfly control (Appendix Table H1). Acreage and insecticide are not specified in the documents; however, lead arsenate presumably was used, as it was the most commonly used insecticide at that time. The largest single insecticide application, DDT, occurred in the Superior National Forest in

The plus (+) sign represents additional treated acreage with incomplete documentation available.

1962 for spruce budworm control (Appendix Table B1). The project encompassed 56,266 acres on 25 separate parcels of land, or 2.7 percent of the federally owned land on that forest.

The greatest total acreage treated in a single year, 1962, in the Lake States national forests was 108,904 acres (Figure 2) in eight forests, or 1.6 percent of the federal ownership. The second largest spray year was 1960 with 29,312 acres (Figure 2) in six national forests receiving treatment, or 0.4 percent of the total federal acreage. No insecticides were applied in 1943, 1944 and 1971.

INSECTICIDES

Four chemicals--lead arsenate, sodium arsenate, DDT, and aldrin--have been used in several projects totalling more than 10,000 acres for each chemical (Figure 3). DDT replaced the arsenates and in turn was replaced in recent years by malathion.

Lead arsenate.--This inorganic insecticide was used during the period 1934-1947. In excess of 31,049 acres (Table 2) were treated with more than 5,704 pounds of chemical (Tables 2, 3). Redheaded pine sawfly control accounted for 30,177+ of the treated acres. Of this acreage, 4,260 acres were sprayed to control a combined redheaded pine sawfly-jack pine sawfly infestation in 1939 on the Manistee National Forest (Table 2). Available records permit calculation of contrasting dosage

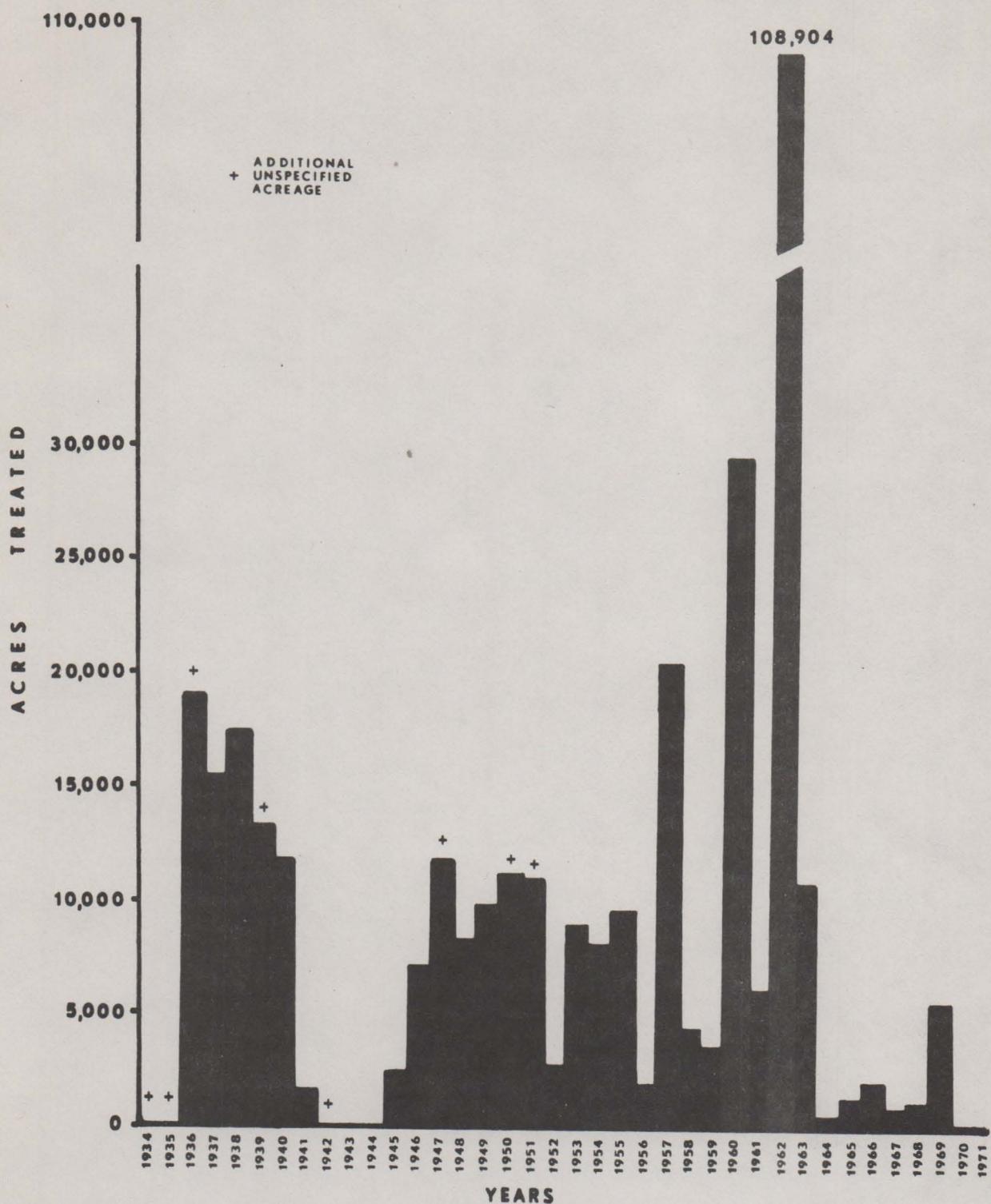


Figure 2. Acreage of Lake States national forest lands treated with insecticides by years, 1934-1971.

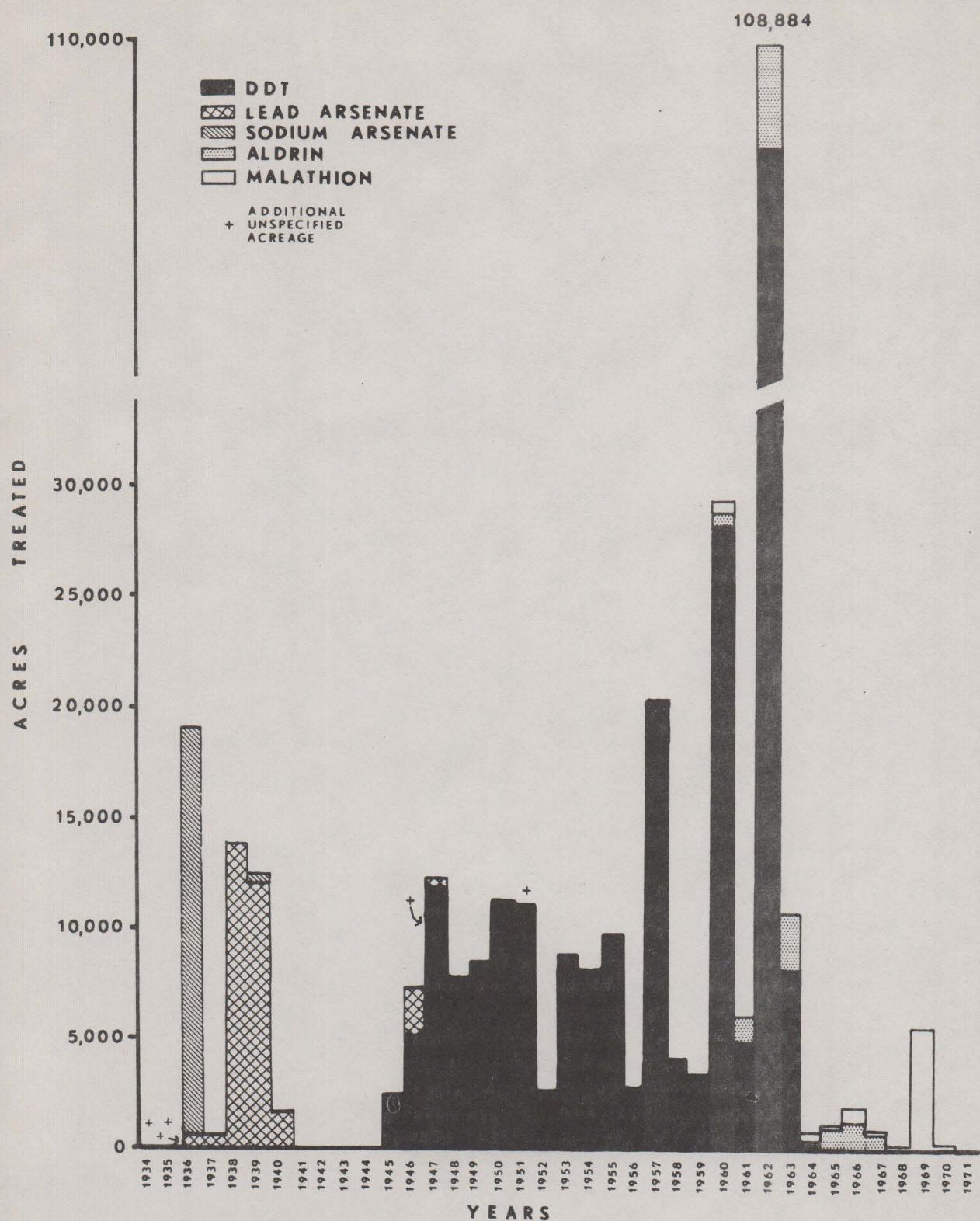


Figure 3. Acreage of Lake States national forest lands treated with specific insecticides by years, 1934-1971.

Table 2.--Insecticide use on the Lake States national forests by insect species, 1934-1971.

Insect species	Insecticide	Period used	Acres treated ^a	Pounds insecticide ^{a,b}	Forest(s) treated
Redheaded pine sawfly ^c	Lead Arsenate	1934-1947	30,177+	1,121+	Chippewa, Nicolet, Hiawatha, Manistee
	Nicotine Sulphate & Lead Arsenate	1939	300	+	Manistee
	Nicotine Sulphate	1939	680	+	Manistee
	DDT	1945-1960	23,809+	12,814+	Chippewa, Chequamegon, Nicolet, Ottawa, Hiawatha, Manistee
	Malathion	1960-1970	345	503	Nicolet, Ottawa, Hiawatha, Manistee
	Unknown	1935	+	+	Chequamegon
	DDT	1945-1964	85,263	83,642+	Chequamegon, Nicolet, Ottawa, Hiawatha, Huron
Saratoga spittlebug ^c	Malathion	1964-1969	6,365	4,658	Chequamegon, Nicolet, Ottawa, Hiawatha, Huron
	DDT	1945-1964	85,263	83,642+	Chequamegon, Nicolet, Ottawa, Hiawatha, Huron
Jack pine budworm	Lead Arsenate	1939	+	+	Chippewa, Superior
	DDT	1950-1964	59,842	59,842	Chippewa, Chequamegon, Hiawatha, Manistee
	Malathion	1964-1966	520	430	Huron, Manistee
	Zectran	1964-1968	515	90	Chequamegon, Manistee
	Dimethoate	1964	15	8	Manistee
Spruce budworm	Matacil	1968	500	75	Chequamegon
	DDT	1957-1963	84,815	81,922	Superior
Forest tent caterpillar	Lead Arsenate	1936-1937	872+	4,583+	Chippewa, Superior
	DDT	1951	664	664	Chippewa
White pine weevil	DDT	1950-1951	400+	720+	Manistee
	Lindane	1958-1962	96	53	Nicolet, Ottawa
Larch sawfly	DDT	1948-1950	380	340	Chippewa, Superior
White grub	Aldrin	1960-1967	12,590	1,507+	Nicolet, Ottawa, Hiawatha
European pine shoot moth	DDT	1952-1962	319	2,501+	Manistee
	Malathion	1960	404	808	Manistee
	Naled	1960	14	+	Manistee
Pine tortoise scale	DDT	1954	25	50	Nicolet
	Lime Sulphur	1954	28	+	Nicolet
Jack pine sawfly ^d	Lead Arsenate	1939	4,260	+	Manistee
	Nicotine Sulphate & Lead Arsenate	1939	300	+	Manistee
	Nicotine Sulphate	1939	680	+	Manistee
Red turpentine beetle	Lindane	1966	20	4	Hiawatha
Grasshopper	Arsenicals	1938	140	+	Hiawatha
	Sodium Arsenate	1936-1939	18,693	+	Manistee
	Sodium Fluosilicate	1948	415	+	Manistee
	Ammonium Sulphate	1949	30	+	Hiawatha
	Chlordane	1949	1,298	195	Manistee
	Unknown	1937-1942	29,783+	+	Manistee
Walking stick	DDT	1950	210	210	Nicolet
Pine tussock moth	DDT	1962	8,735	8,735	Chequamegon
Yellowheaded spruce sawfly	Malathion	1968	61	31	Superior

^aThe plus (+) sign represents treated acreage with incomplete documentation available. Do not add columns for total acres and pounds as some spraying was for two insects and is reported for each.

^bValues are not necessarily pounds active ingredient as formulations were not specified in many reports.

^cCombined redheaded pine sawfly-Saratoga spittlebug spraying on 730 acres with DDT on the Nicolet National Forest.

^dAll jack pine sawfly spraying was in combination with redheaded pine sawfly.

Table 3.--Pounds of selected insecticides used on the Lake States national forests by years, 1934-1971.

Year	Chippewa	Superior	Chequamegon	Nicolet	Ottawa	Hiawatha	Huron	Manistee	Total
<u>LEAD ARSENATE^a</u>									
1934	(b)	(b)	(c)	(b)	(c)	(b)	(c)	+	+
1935	(b)	(b)	(c)	(c)	(c)	(b)	(c)	+	+
1936	+	2,184	(b)	(b)	(b)	+	(b)	+	2,184+
1937	+	2,399	(b)	(b)	(b)	(b)	(b)	(b)	2,399+
1938	(b)	(b)	(b)	(b)	(b)	68+	(b)	+	68+
1939	+	+	(b)	(b)	(b)	984	(b)	+	984+
1940	(b)	(b)	(b)	(b)	(b)	69	(b)	+	69+
1946	(c)	(c)	(c)	(c)	(c)	+	(c)	(c)	+
1947	(b)	(b)	(b)	+	(b)	(b)	(c)	(c)	+
Total	+	4,583+		+		1,121+		+	5,704+
<u>DDT^a</u>									
1945	(c)	(c)	(b)	436	+	+	(c)	(c)	436+
1946	(c)	(c)	+	2,169	+	+	(c)	3,060+	5,229+
1947	(b)	(b)	1,538+	2,850+	1,320+	+	(c)	3,224+	8,932+
1948	60+	(b)	152	1,994	(c)	480+	(c)	2,320+	5,006+
1949	80+	(b)	672+	1,917	2,250+	+	(b)	53	4,972+
1950	(b)	200	+	8,980	510	727	(b)	813+	11,230+
1951	664	(b)	100+	4,294	1,200	4,358	(c)	+	10,616+
1952	(c)	(c)	(c)	1,835	773	(c)	(c)	+	2,608+
1953	(c)	(c)	1,425	4,174	2,188	1,028	(c)	(c)	8,815
1954	(c)	(c)	3,459	2,958	1,240	575	(c)	(c)	8,232
1955	(c)	(c)	2,195	5,271	1,570	357	(c)	(c)	9,393
1956	(c)	(c)	709	2,014	212	(c)	(b)	(b)	2,935
1957	(c)	90	14,910	4,628	(c)	436+	(c)	588	20,652+
1958	(c)	140	616	3,074	(c)	114	(b)	1,871+	5,815+
1959	600	140	575	1,602	(c)	324+	(c)	134	3,375+
1960	1,030	24,168	+	1,958	(c)	794+	(c)	(c)	27,950+
1961	(c)	(c)	2,443	2,154	55	(c)	192	(c)	4,844
1962	24,055	55,465	8,890	1,674	30	12,598	680	42	103,434
1963	(c)	1,919	(c)	(c)	(c)	(c)	4,253	(c)	6,172
1964	(c)	(c)	(c)	(c)	(c)	(c)	4	60	64
Total	26,489+	82,122	37,684+	53,982+	11,348+	21,791+	5,129	12,165+	250,710+

Table 3.--Continued

Year	Chippewa	Superior	Chequamegon	Nicolet	Ottawa	Hiawatha	Huron	Manistee	Total
<u>MALATHION^a</u>									
1960	*(c)	(c)	(c)	(c)	(c)	(c)	(c)	1,212	1,212
1964	(c)	(c)	(c)	(c)	(c)	(c)	146	90	236
1965	(c)	(c)	(c)	4	(c)	(c)	101	(c)	105
1966	(b)	(b)	(b)	11	(b)	(b)	240	200	451
1967	(c)	(c)	(c)	75	(c)	(c)	(c)	(c)	75
1968	(c)	31	2	25	60	(b)	(c)	(c)	118
1969	(b)	(b)	396	(b)	(b)	71	3,681	50	4,198
1970	(c)	(b)	(c)	(c)	1	(c)	(c)	34	35
Total		31	398	115	61	71	4,168	1,586	6,430

^aThe plus (+) sign represents incompletely documented additional pounds used.^bAvailable reports indicate this specific insecticide was not used.^cEither no reports available or report not specific on the insecticide used.

rates. Redheaded pine sawfly colonies were treated individually at an average rate of 0.22 pounds lead arsenate per acre on 5,052 acres sprayed with 1,121 pounds of insecticide. An average rate of 10.7 pounds of lead arsenate per acre was used on 430 acres treated with 4,583 pounds of chemical for forest tent caterpillar control. No records of lead arsenate use on the Chequamegon, Ottawa and Huron National Forests have been found.

Sodium arsenate.--Grasshoppers were controlled on the Manistee National Forest where a total of 18,693 acres was treated with sodium arsenate in 1936 and 1939 (Table 2).

DDT.--DDT was first used in 1945 and continued in use until 1964 (Figure 3). In the final year, 1964, the acreage treated was experimental to evaluate the effectiveness of other chemicals as compared with DDT. During the 20-year period

264,462+ acres (Table 2) were treated with 250,710+ pounds of chemical (Table 3), averaging about one pound DDT per acre.

On the Nicolet National Forest 730 acres were treated for both redheaded pine sawfly and Saratoga spittlebug with the same insecticide application. Major DDT use was for control of redheaded pine sawfly, Saratoga spittlebug, jack pine budworm, spruce budworm, and pine tussock moth (Table 2).

Aldrin.--Soil insect control projects were carried out between 1960 and 1967 on 12,590 acres of white grub infested land. Over 1,500 pounds of aldrin were applied (Table 2; Figure 3).

Malathion.--As a substitute for DDT, malathion was first used in 1960 (Table 3; Figure 3). Insect control projects or experiments using malathion occurred in 1960 and 1964, through 1970. Five insect species--redheaded pine sawfly, yellowheaded spruce sawfly, Saratoga spittlebug, jack pine budworm, European pine shoot moth--have been treated on 7,695 acres with 6,430 pounds of chemical (Tables 2,3) for an average dosage rate of about 0.8 pounds malathion per acre.

Other chemicals.--Besides sodium arsenate, grasshoppers were controlled with a number of chemicals between 1938 and 1949 (Table 2). Nicotine sulphate was used in 1939 to control a combined redheaded pine sawfly-jack pine sawfly infestation on 680 acres of the Manistee National Forest. An additional 300 acres were treated with nicotine sulphate and lead arsenate either mixed together in the spray tank or applied separately

on portions of the area--the records are not specific on this point.

A small infestation of pine tortoise scale was treated with lime sulphur in 1954 on the Nicolet National Forest. In 1960 naled was used on 14 acres of Manistee National Forest infested with European pine shoot moth (Table 2). Zectran, matacil and dimethoate were tested for control of the jack pine budworm in 1964 and/or 1968. Lindane was tested for white pine weevil control on the Ottawa and Nicolet National Forests from 1958 to 1962. Lindane was used in 1966 to suppress a 20 acre red turpentine beetle infestation in red pine seed trees on the Hiawatha National Forest.

DATA AVAILABILITY

The lack of project reports, including negative reports, and incomplete data in some existing reports regrettably reduces the value of those reports. Often summaries and reports not intended to give complete project data were utilized in lieu of project reports. Reports of any kind are lacking for some years on each forest (Table 3).

About 400 projects are recorded here. The insecticide used was not specified or only vaguely referred to, e.g. arsenicals, for 31 projects; however, inferences could be made for 23 of these. (See appendix for explanation of inferences.) The carrier was omitted in 87 projects; however, inferences could

be made in 66 cases. The rate of application was not specified for 165 projects, but it could be calculated for 48 projects and inferred for 19 others. The total pounds of insecticide used was reported for only 14 projects. Subsequently, application rates could not be calculated for each project, especially ground applications such as mistblowers and hand sprayers. The insecticide concentration and formulation were often omitted, creating some doubts when considering the pounds of insecticide specified as active ingredient. Application method is unknown for 25 projects and inferred for 21 others.

Location data was not included in many reports. Legal land descriptions were omitted often, and for 16 projects either the ranger district was not listed or districts were combined. The acreage was not given for 15 projects.

APPENDIX

The tables that follow are arranged by National Forest:

- Series A Chippewa National Forest
- Series B Superior National Forest
- Series C Chequamegon National Forest
- Series D Nicolet National Forest
- Series E Ottawa National Forest
- Series F Hiawatha National Forest
- Series G Huron National Forest
- Series H Manistee National Forest

Table 1 within each Forest series, A1, B1, etc., chronologically lists target insect species and gives the insecticide application data for each insect on that forest. Tables A2, A3, B2, B3, etc., each contain insecticide use data for a specific insect species or a small group of species entered by ranger district.

Five footnotes, (a) thru (e), are used throughout the appendix tables. Footnote (a) refers to the methods of application, as follows:

A=aerial.--includes both helicopter and fixed-wing aircraft

B=mist-blower.--insecticide injected into fast-moving large-volume air flow; includes vehicle mounted and back-pack equipment

C=hydraulic sprayer.--large volume of liquid carrier for the insecticide; vehicle mounted machine

D=hand sprayer.--back-pack or knapsack hydraulic sprayer; includes modified back-pack sprayer fitted with a wand for soil insertion of insecticide

E=planting machine.--attachment to planting machine for application of insecticides into the soil during tree planting

F=hand dipped planting stock.--tree roots dipped in insecticide before planting

G=broadcast on ground surface.--machine or hand equipment dispensing insecticide, e.g. baits, on ground surface

Footnote (b) indicates the value was calculated from data presented in this report or the source document.

Footnote (c) shows the lack of data, nd=no data, and means the available project records were incomplete or only summaries or other documents which were not meant to be complete project reports were used.

Footnote (d) indicates the data were derived by inference from information presented in the source documents, from insect control activities on neighboring ranger district(s) or national forests, and from knowledge of practices and procedures in vogue at the time. An entry of the type DDT + oil indicates that the carrier is inferred whereas DDT + oil means both the insecticide and carrier are inferred.

Footnote (e) indicates the total pounds of insecticide used was included in the source document; therefore, footnote (b) does not apply to this value.

Certain insecticides carry a formulation designation and are defined as:

EC=emulsifiable concentrate. A chemical (emulsifying agent) has been added so the insecticide can be mixed with water.

C=concentrate. The insecticide was used in an undiluted form.

G=granular. The insecticide was mixed or coated with an inert ingredient and applied dry.

The data used in this report were compiled from unpublished project reports, memos, pest control atlases and other documents. These reports were originated by the eight National Forests, the Eastern Region Office (formerly North Central Region), North Central Forest Experiment Station (formerly the Lake States Forest Experiment Station), the Milwaukee Laboratory of the Bureau of Entomology and Plant Quarantine, and the St. Paul Field Office of the Northeastern Area State and Private Forestry. The source documents are on file in the St. Paul Field Office, Room 638 Federal Courts Building, 316 Robert Street, St. Paul, Minnesota 55101.

Anyone interested in tracing the history of activities in the national forests of the Lake States should be aware of forest establishment dates and name changes. A brief history is included in this report.

Most of the national forests in the Lake States came into existence as purchase units and later gained status as national forests by presidential proclamation. The Superior National Forest was created in 1909. The Chippewa National Forest was

established as the Minnesota National Forest in 1923 and received its current name in 1928. Proclamations established the Ottawa National Forest in 1931, the Nicolet National Forest in 1933, and the Chequamegon National Forest in 1936.

The East Unit of the Hiawatha National Forest was proclaimed the Marquette National Forest, in 1909, made part of the Michigan National Forest in 1915, and in 1928 again was proclaimed the Marquette National Forest. The West Unit of the Hiawatha National Forest received National Forest status in 1931. About 1935 the Hiawatha and Marquette National Forests were combined administratively and referred to as the Upper Michigan National Forests. This arrangement continued until the Marquette National Forest was abolished by an executive order in 1962 and made part of the Hiawatha National Forest.

The Huron National Forest was established in 1909 as the Michigan National Forest receiving the name Huron National Forest prior to 1936. The Manistee National Forest was proclaimed in 1938. About 1946 the Huron and Manistee National Forests were combined administratively and called the Lower Michigan National Forests. In 1964 the Forests became known as the Huron-Manistee National Forests.

Table A1.--Chronological summary of insecticide use in the Chippewa National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1936	Forest tent caterpillar	nd ^c	Lead Arsenate + water ^d	C	nd	nd
1937	Forest tent caterpillar	442	Lead Arsenate + water ^d	C	nd	nd
1939	Redheaded pine sawfly	11	Lead Arsenate + water ^d	C	nd	nd
	Jack pine budworm	nd	Lead Arsenate ^d + water ^d	C	nd	nd
1948	Redheaded pine sawfly	93	DDT + oil	D	nd	nd
	Larch sawfly	100-E	DDT + oil	A	0.6	60
1949	Redheaded pine sawfly	95	DDT + oil	D	nd	nd
	Larch sawfly	80-E	DDT + oil	A	1	80
1951	Forest tent caterpillar	664 ^b	DDT + oil	A	1	664
1959	Jack pine budworm	600	DDT + oil ^d	A	1	600
1960	Jack pine budworm	1,030	DDT + oil ^d	C	1	1,030
1962	Jack pine budworm	24,055	DDT + oil	A	1	24,055

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table A2.--Insecticidal control of redheaded pine sawfly, jack pine budworm, forest tent caterpillar, and larch sawfly in the Chippewa National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
<u>REDHEADED PINE SAWFLY</u>						
Cass Lake	1939	11	Lead Arsenate + water ^d	C	nd ^c	nd
Remer	1948	93	DDT + oil	D	nd	nd
	1949	95	DDT + oil	D	nd	nd
<u>JACK PINE BUDWORM</u>						
Cass Lake	1939	nd	Lead Arsenated + water ^d	C	nd	nd
	1959	600	DDT + oil ^d	A	1	600
	1960	1,030	DDT + oil ^d	C	1	1,030
Cass Lake & Bena	1962	24,055	DDT + oil	A	1	24,055
<u>FOREST TENT CATERPILLAR</u>						
Cass Lake ^d	1936	nd	Lead Arsenate + water ^d	C	nd	nd
Unknown	1937	442	Lead Arsenate + water ^d	C	nd	nd
	1951	664 ^b	DDT + oil	A	1	664
<u>LARCH SAWFLY</u>						
Bena	1948	100-E	DDT + oil	A	0.6	60
Cass Lake	1949	80-E	DDT + oil	A	1	80 ^e

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table B1.--Chronological summary of insecticide use in the Superior National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1936	Forest tent caterpillar	195	Lead Arsenate + water ^d	C	11.2 ^b	2,184
1937	Forest tent caterpillar	80	Lead Arsenate + water ^d	C	10.8 ^b	864
	Forest tent caterpillar	155	Lead Arsenate + water ^d	C	9.9 ^b	1,535
1939	Jack pine budworm	nd ^c -E	Lead Arsenate + water	C	nd	nd
1950	Larch sawfly	200-E	DDT ^d + oil ^d	A	1 ^d	200
1957	Spruce budworm	90-E	DDT + oil	A	1	90
1958	Spruce budworm	140-E	DDT + oil	A	1	140
1959	Spruce budworm	140-E	DDT + oil	A	1	140
1960	Spruce budworm	354	DDT + oil	A	0.5	178
	Spruce budworm	23,990	DDT + oil	A	1	23,990
1962	Spruce budworm	1,606	DDT + oil	A	0.5	805
	Spruce budworm	54,660	DDT + oil	A	1	54,660
1963	Spruce budworm	3,835	DDT + oil	A	0.5	1,919
1968	Yellowheaded spruce sawfly	61	Malathion + water	B	0.5	31

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table B2.--Insecticidal control of spruce budworm in the Superior National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Gunflint	1960	147	DDT + oil	A	0.5	74
	1960	9,030	DDT + oil	A	1	9,030
	1962	527	DDT + oil	A	0.5	264
	1962	40,044	DDT + oil	A	1	40,044
	1963	1,533	DDT + oil	A	0.5	767
Halfway	1958	40-E	DDT + oil	A	1	40
	1959	40-E	DDT + oil	A	1	40
	1960	105	DDT + oil	A	0.5	53
	1962	185	DDT + oil	A	0.5	93
	1962	8,746	DDT + oil	A	1	8,746
	1963	533	DDT + oil	A	0.5	267
Isabella	1962	249	DDT + oil	A	0.5	125
	1963	523	DDT + oil	A	0.5	262
Kawishiwi	1958	20-E	DDT + oil	A	1	20
	1959	20-E	DDT + oil	A	1	20
	1960	32	DDT + oil	A	0.5	16
	1962	30	DDT + oil	A	0.5	15
	1963	386	DDT + oil	A	0.5	193
LaCroix	1957	90-E	DDT + oil	A	1	90
	1958	80-E	DDT + oil	A	1	80
	1959	80-E	DDT + oil	A	1	80
	1960	70	DDT + oil	A	0.5	35
	1960	1,590	DDT + oil	A	1	1,590
	1962	190	DDT + oil	A	0.5	95
	1963	358	DDT + oil	A	0.5	179
Tofte	1960	13,370	DDT + oil	A	1	13,370
	1962	250	DDT + oil	A	0.5	125
	1962	5,870	DDT + oil	A	1	5,870
	1963	502	DDT + oil	A	0.5	251
Virginia	1962	175	DDT + oil	A	0.5	88

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table B3.--Insecticidal control of forest tent caterpillar in the Superior National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Gunflint	1936	66	Lead Arsenate + water ^d	C	11.2 ^b	739
	1937	80	Lead Arsenate + water ^d	C	10.8 ^b	864
Halfway	1936	20	Lead Arsenate + water ^d	C	11.2 ^b	224
	1937	155	Lead Arsenate + water ^d	C	9.9 ^b	1,535
Kawishiwi	1936	58	Lead Arsenate + water ^d	C	11.2 ^b	650
LaCroix	1936	36	Lead Arsenate + water ^d	C	11.2 ^b	403
Tofte	1936	15	Lead Arsenate + water ^d	C	11.2 ^b	168

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cInference: see page 15.

Table B4.--Insecticidal control of jack pine budworm, larch sawfly, and yellowheaded spruce sawfly in the Superior National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
<u>JACK PINE BUDWORM</u>						
Gunflint	1939	nd ^c E	Lead Arsenate + water	C	nd	nd
<u>LARCH SAWFLY</u>						
Kawishiwi	1950	200-E	DDT ^d + oil ^d	A	1 ^d	200
<u>YELLOWHEADED SPRUCE SAWFLY</u>						
Two Harbors	1968	61	Malathion + water	B	0.5	31

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table C1.--Chronological summary of insecticide use in the Chequamegon National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1935	Redheaded pine sawfly	nd ^c	nd	nd	nd	nd
1946	Redheaded pine sawfly	50	DDT + oil or water	nd	nd	nd
1947	Redheaded pine sawfly	1,177	DDT + oil	D	nd	nd
	Redheaded pine sawfly	1,025	DDT + oil	A	0.5	513
	Redheaded pine sawfly	1,025	DDT + oil	A	1	1,025
1948	Redheaded pine sawfly	1,685	DDT + oil	D	0.09 ^b	152
1949	Redheaded pine sawfly	2,533	DDT + oil	D	0.17 ^b	431
	Redheaded pine sawfly	425	DDT + oil	D	0.19 ^b	81
	Redheaded pine sawfly	700	DDT + oil	D	0.21 ^b	147
	Redheaded pine sawfly	50	DDT + oil	D	0.25	13
	Saratoga spittlebug	55	DDT + oil	B	nd	nd
1950	Redheaded pine sawfly	160	DDT ^d + oil ^d	nd	nd	nd
	Redheaded pine sawfly	nd	DDT ^d + oil ^d	nd	nd	nd
1951	Redheaded pine sawfly	110	DDT + oil	D	nd	nd
	Saratoga spittlebug	60	DDT + oil	A	1	60
	Saratoga spittlebug	80	DDT + oil	B	0.5	40
1953	Saratoga spittlebug	1,425	DDT + oil	A ^d	1	1,425
1954	Saratoga spittlebug	3,459	DDT + oil	A	1	3,459
1955	Saratoga spittlebug	2,195	DDT + oil	A	1	2,195
1956	Saratoga spittlebug	709	DDT + oil	A	1	709
1957	Saratoga spittlebug	489	DDT + oil	A	1	489
	Jack pine budworm	14,421	DDT + oil	A	1	14,421
1958	Saratoga spittlebug	616	DDT + oil	A	1	616
1959	Saratoga spittlebug	575	DDT + oil	A	1	575
1960	Redheaded pine sawfly	40	DDT + oil ^d	D	nd	nd
1961	Saratoga spittlebug	43	DDT + oil	A ^d	1	43
	Jack pine budworm	2,400	DDT + oil	A	1	2,400
1962	Saratoga spittlebug	155	DDT + oil	A	1	155
	Pine tussock moth	8,735	DDT + oil	A	1	8,735

Table C1.--Continued

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1968	Saratoga spittlebug	3	Malathion C	A	0.75 ^b	2
	Jack pine budworm	500-E	Zectran + Dowanol DB		0.15	75
	Jack pine budworm	500-E	Matacil + Dowanol DB		0.15	75
1969	Saratoga spittlebug	528	Malathion C	A	0.75 ^b	396

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table C2.--Insecticidal control of jack pine budworm and pine tussock moth in the Chequamegon National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Pounds per acre	Total pounds ^b
<u>JACK PINE BUDWORM</u>						
Washburn	1957	14,421	DDT + oil	A	1	14,421
	1961	2,400	DDT + oil	A	1	2,400
	1968	500-E	Zectran + Dowanol DB	A	0.15	75
	1968	500-E	Matacil + Dowanol DB	A	0.15	75
<u>PINE TUSSOCK MOTH</u>						
Washburn	1962	8,735	DDT + oil	A	1	8,735

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table C3.--Insecticidal control of redheaded pine sawfly in the Chequamegon National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	Total pounds ^b
					Pounds per acre	
Glidden	1949	700	DDT + oil	D	0.21 ^b	147
	1950	nd ^c	DDT ^d + oil ^d	nd	nd	nd
Glidden & Hayward	1947	950	DDT + oil	A	1	950
	1947	280	DDT + oil	D	nd	nd
Hayward	1949	2,533	DDT + oil	D	0.17 ^b	431
	1950	160	DDT ^d + oil ^d	nd	nd	nd
	1960	40	DDT + oil ^d	D	nd	nd
Park Falls & Hayward	1948	1,685	DDT + oil	D	0.09 ^b	152
Park Falls	1946	50	DDT + oil or water	nd	nd	nd
	1947	1,025	DDT + oil	A	0.5	513
	1947	75	DDT + oil	A	1	75
	1947	136	DDT + oil	D	nd	nd
	1949	50	DDT + oil	D	nd	nd
Washburn	1949	425	DDT + oil	D	0.19 ^b	81
Unknown	1935	nd	nd	nd	nd	nd
	1947	761	DDT + oil	D	nd	nd
	1951	110	DDT + oil	D	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table C4.--Insecticidal control of Saratoga spittlebug in the Chequamegon National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Glidden	1951	80	DDT + oil	B	0.5	40
	1955	40	DDT + oil	A	1	40
	1956	398	DDT + oil	A	1	398
	1957	241	DDT + oil	A	1	241
	1958	60	DDT + oil	A	1	60
	1968	3	Malathion C	A	0.75 ^b	2
Hayward	1954	70	DDT + oil	A	1	70
	1955	190	DDT + oil	A	1	190
	1956	100	DDT + oil	A	1	100
	1957	40	DDT + oil	A	1	40
	1962	40	DDT + oil	A	1	40
Park Falls	1949	55	DDT + oil	B	nd	nd
	1951	60	DDT + oil	A	1	60
	1953	1,425	DDT + oil	A ^d	1	1,425
	1954	1,809	DDT + oil	A	1	1,809
	1955	1,430	DDT + oil	A	1	1,430 ^e
	1957	208	DDT + oil	A	1	208
	1958	556	DDT + oil	A	1	556
	1959	575	DDT + oil	A	1	575
	1961	43	DDT + oil	A ^d	1	43
Washburn	1962	115	DDT + oil	A	1	115
	1954	1,580	DDT + oil	A	1	1,580
	1955	535	DDT + oil	A	1	535
	1956	211	DDT + oil	A	1	211
	1969	528	Malathion C	A	0.75 ^b	396

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table D1.--Chronological summary of insecticide use in the Nicolet National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1945	Saratoga spittlebug	43-E	DDT + Kerosene	A	0.25	11
	Saratoga spittlebug	43-E	DDT + Kerosene	A	0.5	22
	Saratoga spittlebug	39-E	DDT + Kerosene	A	1	39
	Saratoga spittlebug	23-E	DDT + oil	A	0.25	6
	Saratoga spittlebug	37-E	DDT + oil	A	0.5	19
	Saratoga spittlebug	274-E	DDT + oil	A	1	274
	Saratoga spittlebug	10-E	DDT + oil	A	2	20
	Saratoga spittlebug	9-E	DDT + oil	A	5	45
1946	Saratoga spittlebug	118-E	DDT + oil	A	0.5	59
	Saratoga spittlebug	367-E	DDT + oil	A	0.92	338
	Saratoga spittlebug	458-E	DDT + oil	A	1	458
	Saratoga spittlebug	657-E	DDT + oil	A	2	1,314
1947	Redheaded pine sawfly	87	Lead Arsenate	D	nd	nd
	Redheaded pine sawfly	nd ^c	DDT	nd	nd	nd
	Saratoga spittlebug	2,450	DDT + oil ^d	A	1	2,450
	Saratoga spittlebug	200-E	DDT + oil	A	1	200
	Saratoga spittlebug	100-E	DDT + oil	A	2	200
1948	Redheaded pine sawfly	452	DDT + oil	D	1	452
	Redheaded pine sawfly	293	DDT + oil	A	1	293
	Redheaded pine sawfly & Saratoga spittlebug	256	DDT + oil	A	1	256
	Saratoga spittlebug	993	DDT ^d + oil ^d	A ^d	1	993
1949	Redheaded pine sawfly	307	DDT + oil	D	1 ^d	307
	Redheaded pine sawfly & Saratoga spittlebug	449	DDT + oil	A	1	449
	Redheaded pine sawfly & Saratoga spittlebug	25	DDT + oil	D	1 ^d	25
	Saratoga spittlebug	63	DDT + oil	D	1 ^d	63
	Saratoga spittlebug	1,073	DDT + oil	A	1	1,073
	Saratoga spittlebug	8,770	DDT + oil	nd	1	8,770
1950	Walking stick	210	DDT + oil	A	1	210
	Saratoga spittlebug	4,294	DDT + oil	A	1	4,294
1952	Saratoga spittlebug	1,835	DDT ^d + oil ^d	A ^d	1 ^d	1,835
1953	Saratoga spittlebug	4,174	DDT ^d + oil ^d	A ^d	1 ^d	4,174
1954	Saratoga spittlebug	2,908	DDT + oil	A	1	2,908
	Pine tortoise scale	25-E	DDT EC + water	A	2	50
	Pine tortoise scale	28	Lime sulphur + water	C	nd	nd
1955	Saratoga spittlebug	5,271	DDT + oil ^d	A	1	5,271
1956	Saratoga spittlebug	2,014	DDT + oil	A	1	2,014
1957	Saratoga spittlebug	4,628	DDT + oil	A	1	4,628

Table D1.--Continued.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1958	Redheaded pine sawfly	10	DDT + oil	A	1	10
	Saratoga spittlebug	3,064	DDT + oil	A	1	3,064
1959	Saratoga spittlebug	1,602	DDT + oil	A	1	1,602
1960	Saratoga spittlebug	1,958	DDT + oil	A	1	1,958
	White grub	516	Aldrin EC + water	F	nd	nd
1961	Saratoga spittlebug	2,154	DDT + oil	A	1	2,154
	White grub	365	Aldrin EC + water	F	nd	nd
1962	Saratoga spittlebug	30	DDT + oil	D	1	30
	Saratoga spittlebug	1,564	DDT + oil	A ^d	1	1,564
	Saratoga spittlebug	160	DDT + oil	A	0.5	80
	White pine weevil	5-E	Lindane EC + water	B	0.13 ^b	0.6
	White pine weevil	5-E	Lindane EC + water	B	0.05 ^b	0.3
	White grub	1,488	Aldrin EC + water	F	nd	nd
1965	Saratoga spittlebug	4-E	Malathion + Panasol AN-5	B	0.13	0.6
	Saratoga spittlebug	4-E	Malathion + Panasol AN-5	B	0.25	1
	Saratoga spittlebug	4-E	Malathion + Panasol AN-5	B	0.5	2
1966	Redheaded pine sawfly	14	Malathion + water	B	0.8	11
1967	Saratoga spittlebug	149	Malathion + water	A	0.5	75
1968	Saratoga spittlebug	12	Malathion + water	B	0.5	25 ^e

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table D2.--Insecticidal control of Saratoga spittlebug in the Nicolet National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Eagle River	1945	43-E	DDT + kerosene	A	0.25	11
	1945	43-E	DDT + kerosene	A	0.5	22
	1945	39-E	DDT + kerosene	A	1	39
	1945	23-E	DDT + oil	A	0.25	6
	1945	37-E	DDT + oil	A	0.5	19
	1945	274-E	DDT + oil	A	1	274
	1945	10-E	DDT + oil	A	2	20
	1945	9-E	DDT + oil	A	5	45
	1947	100-E	DDT + oil	A	2	200
	1947	200-E	DDT + oil	A	1	200
	1947	2,110	DDT + oil ^d	A	1	2,110
	1948	120	DDT + oil	A	1	120
	1952	52	DDT ^d + oil ^d	A ^d	1 ^d	52
	1953	469	DDT ^d + oil ^d	A ^d	1 ^d	469
Florence	1954	615	DDT + oil	A	1	615
	1955	1,136	DDT + oil ^d	A	1	1,136
	1957	239	DDT + oil	A	1	239
	1958	10	DDT + oil	A	1	10
	1959	160	DDT + oil	A	1	160
	1960	100	DDT + oil	A	1	100
	1948	450	DDT ^d + oil ^d	A ^d	1 ^d	450
	1949	610	DDT + oil	A	1	610
Lakewood	1953	890	DDT ^d + oil ^d	A ^d	1 ^d	890
	1955	414	DDT + oil ^d	A	1	414
	1956	754	DDT + oil	A	1	754
	1957	797	DDT + oil	A	1	797
	1958	600	DDT + oil	A	1	600
	1961	140	DDT + oil	A	1	140
	1962	30	DDT + oil	D	1	30
	1946	118-E	DDT + oil	A	0.5	59
	1946	367-E	DDT + oil	A	0.92	338
	1946	458-E	DDT + oil	A	1	458
	1946	657-E	DDT + oil	A	2	1,314
	1947	340	DDT + oil ^d	A	1	340
	1948	423	DDT + oil	A	1	423
	1949	762	DDT + oil	A	1	762
	1949	48	DDT + oil	D	1	48
	1950	3,840	DDT + oil	A	1	3,840
	1951	2,115	DDT + oil	A	1	2,115
	1952	1,113	DDT + oil	A	1	1,113
	1953	240	DDT + oil	A	1	240
	1954	1,143	DDT + oil	A	1	1,143

Table D2.--Continued.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Lakewood	1955	2,484	DDT + oil	A	1	2,484
	1956	1,180	DDT + oil	A	1	1,180
	1957	2,543	DDT + oil	A	1	2,543
	1958	2,047	DDT + oil	A	1	2,047
	1959	1,392	DDT + oil	A	1	1,392
	1960	1,807	DDT + oil	A	1	1,807
	1961	1,884	DDT + oil	A	1	1,884
	1962	1,424	DDT + oil	A	1	1,424
	1962	160	DDT + oil	A	0.5	80
	1967	149	Malathion + water	A	0.5	75
Laona	1949	150	DDT + oil	A	1	150
	1949	40	DDT + oil	D	1 ^d	40
	1953	995	DDT + oil	A	1	995
	1954	1,085	DDT + oil	A	1	1,085
	1955	1,027	DDT + oil	A	1	1,027
	1956	80	DDT + oil	A	1	80
	1957	1,049	DDT + oil	A	1	1,049
	1958	105	DDT + oil	A	1	105
	1959	50	DDT + oil	A	1	50
	1960	51	DDT + oil	A	1	51
	1962	140	DDT + oil	A ^d	1	140
	1965	2-E	Malathion + Panasol AN-5	B	0.13	0.3
	1965	2-E	Malathion + Panasol AN-5	B	0.25	0.5
	1965	2-E	Malathion + Panasol AN-5	B	0.5	1
Three Lakes	1952	650	DDT ^d + oil ^d	A ^d	1 ^d	650
	1953	1,580	DDT ^d + oil ^d	A ^d	1 ^d	1,580
	1954	65	DDT + oil	A	1	65
	1955	210	DDT + oil	A	1	210
	1958	302	DDT + oil	A	1	302
	1961	130	DDT + oil	A	1	130
	1965	2-E	Malathion + Panasol AN-5	B	0.13	0.3
	1965	2-E	Malathion + Panasol AN-5	B	0.25	0.5
	1965	2-E	Malathion + Panasol AN-5	B	0.5	1
	1968	12	Malathion + water	B	2 ^b	25 ^e

Table D2.--Continued.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Unknown	1950	4,930	DDT + oil	A	1	4,930
	1951	2,179	DDT + oil	A	1	2,179

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table D3.--Insecticidal control of redheaded pine sawfly in the Nicolet National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Eagle River	1958	10	DDT + oil	A	1	10
Florence	1948	293	DDT + oil	A	1	293 ^e
	1948	141	DDT + oil	D	1 ^d	141
	1949	7	DDT + oil	D	1 ^d	7
Lakewood	1947	nd ^c	DDT	nd	nd	nd
	1948	256	DDT + oil	A	1	256
	1948	228	DDT + oil	D	1	228
	1949	150	DDT + oil	D	1 ^d	150
	1949	449	DDT + oil	A	1	449
	1966	14	Malathion + water	B	0.8	11
Laona	1947	87	Lead Arsenate	D	nd	nd
	1948	83	DDT + oil	D	1 ^d	83
	1949	175	DDT + oil	D	1 ^d	175

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table D4.--Insecticidal control of white pine weevil, pine tortoise scale, and walking stick in the Nicolet National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
<u>WHITE PINE WEEVIL</u>						
Lakewood	1962	5-E	Lindane EC + water	B	0.13 ^b	0.6
	1962	5-E	Lindane EC + water	B	0.05 ^b	0.3
<u>PINE TORTOISE SCALE</u>						
Lakewood ^d	1954	25-E	DDT EC + water	A	2	50
	1954	28	Lime sulphur + water	C	nd ^c	nd
<u>WALKING STICK</u>						
Lakewood	1950	210	DDT + oil	A	1	210

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table DS.--Insecticidal control of white grub in the Nicolet National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Eagle River	1960	372	Aldrin EC + water	F	nd ^c	nd
	1961	99	Aldrin EC + water	F	nd	nd
	1962	618	Aldrin EC + water	F	nd	nd
Florence	1960	35	Aldrin EC + water	F	nd	nd
	1961	106	Aldrin EC + water	F	nd	nd
	1962	340	Aldrin EC + water	F	nd	nd
Lakewood	1960	25	Aldrin EC + water	F	nd	nd
	1961	107	Aldrin EC + water	F	nd	nd
	1962	239	Aldrin EC + water	F	nd	nd
Laona	1960	15	Aldrin EC + water	F	nd	nd
	1961	37	Aldrin EC + water	F	nd	nd
	1962	100	Aldrin EC + water	F	nd	nd
Three Lakes	1960	69	Aldrin EC + water	F	nd	nd
	1961	16	Aldrin EC + water	F	nd	nd
	1962	191	Aldrin EC + water	F	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

Table E1.--Chronological summary of insecticide use in the Ottawa National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1945	Saratoga spittlebug	65	DDT	nd ^c	nd	nd
1946	Saratoga spittlebug	220-E	DDT + oil	A	1&2	nd
1947	Redheaded pine sawfly	25	DDT	D	nd	nd
	Saratoga spittlebug	1,320	DDT + oil	A	1	1,320
1949	Redheaded pine sawfly	3	DDT + oil	D	nd	nd
	Saratoga spittlebug	2,250	DDT + oil	A	1	2,250
1950	Saratoga spittlebug	500	DDT + oil	nd	1	500
	Saratoga spittlebug	5-E	DDT + water	D	2	10
1951	Saratoga spittlebug	1,200	DDT + oil ^d	A	1 ^d	1,200
1952	Saratoga spittlebug	773	DDT + oil ^d	A ^d	1 ^d	773
1953	Saratoga spittlebug	2,188	DDT + oil ^d	A ^d	1 ^d	2,188
1954	Saratoga spittlebug	1,240 ^d	DDT + oil	A	1	1,240
1955	Saratoga spittlebug	1,776	DDT + oil ^d	A	1	1,570
1956	Saratoga spittlebug	212	DDT + oil ^d	A	1 ^d	212
1958	White pine weevil	23-E	Lindane EC + Aroclor + Xylene + water	D	0.05 ^b	1.2
1959	White pine weevil	50-E	Lindane + Aroclor + xylene + oil	A	1 ^b	50
	White pine weevil	3-E	Lindane EC + Aroclor + xylene + water	D	0.13 ^b	0.4
1961	Saratoga spittlebug	55	DDT + oil ^d	A ^d	1	55
1962	Saratoga spittlebug	30	DDT	nd	1	30
	White pine weevil	5-E	Lindane EC + water	B	0.03 ^b	0.2
	White pine weevil	5-E	Lindane EC + water	B	0.05 ^b	0.3
	White grub	232	Aldrin EC ^d + water ^d	F	nd	nd
1968	Saratoga spittlebug	120	Malathion	A	0.5 ^b	60 ^e
1970	Redheaded pine sawfly	1-E	Malathion + water	B	0.5	0.5 ^e

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table E2.--Insecticidal control of Saratoga spittlebug in the Ottawa National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Bessemer	1947	165	DDT + oil	A	1	165
	1949	126	DDT + oil	A	1	126
	1951	300	DDT + oil ^d	A	1 ^d	300
	1954	337 ^d	DDT + oil	A	1	337
	1955	142	DDT + oil ^d	A	1	142
Iron River	1945	65	DDT	nd ^c	nd	nd
	1946	220-E	DDT + oil	A	1&2	nd
	1947	275	DDT + oil	A	1	275
	1952	20	DDT + oil ^d	A ^d	1 ^d	20
	1954	155	DDT + oil	A	1	155
	1956	212	DDT + oil ^d	A	1 ^d	212
Kenton	1947	715	DDT + oil	A	1	715
	1949	2,124	DDT + oil	A	1	2,124
	1950	440	DDT + oil	A	1.05 ^b	460 ^e
	1951	900	DDT + oil	A	1	900
	1952	540	DDT + oil	A	1	540
	1953	1,080	DDT + oil	A	1	1,080
	1954	499	DDT + oil	A	1	499
	1955	887	DDT + oil ^d	A	1	887
Ontonagon	1955	320	DDT + oil ^d	A	1	320
Watersmeet	1947	165	DDT + oil	A	1	165
	1950	5-E	DDT + water	D	2	10 ^e
	1950	60	DDT + oil	A ^d	1	60
	1952	213	DDT + oil ^d	A ^d	1 ^d	213
	1953	500	DDT + oil ^d	A ^d	1 ^d	500
	1954	156 ^d	DDT + oil	A	1	156
	1955	427	DDT + oil ^d	A	1	427
	1961	55	DDT + oil ^d	A ^d	1	55
	1962	30	DDT	nd	1	30
	1968	120	Malathion	A	0.5 ^b	60 ^e
Unknown	1953	608	DDT + oil	A	1	608
	1954	80	DDT + oil	A	1	80
	1954	13	DDT + water	D	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table E3.--Insecticidal control of white pine weevil in the Ottawa National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Bessemer	1958	23-E	Lindane EC + Aroclor + xylene + water	D	0.05 ^b	1.2
Iron River	1959	50-E	Lindane + Aroclor + xylene + oil	A	1 ^b	50
	1959	3-E	Lindane EC + Aroclor + xylene + water	D	0.13 ^b	0.4
	1962	5-E	Lindane EC + water	B	0.03 ^b	0.2
	1962	5-E	Lindane EC + water	B	0.05 ^b	0.3

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table E4.--Insecticidal control of redheaded pine sawfly and white grub in the Ottawa National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
<u>REDHEADED PINE SAWFLY</u>						
Bessemer	1947	25	DDT	D	nd ^c	nd
	1949	3	DDT + oil	D	nd	nd
	1970	1-E	Malathion + water	B	0.5	0.5 ^e
<u>WHITE GRUB</u>						
Bergland	1962	72	Aldrin EC ^d + water ^d	F	nd	nd
Kenton	1962	160	Aldrin EC ^d + water ^d	F	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table Fl.--Chronological summary of insecticide use in the Hiawatha National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1936	Redheaded pine sawfly	454	Lead Arsenate	D	nd ^c	nd
1938	Redheaded pine sawfly	1,587	Lead Arsenate	D	nd	nd
	Redheaded pine sawfly	2,260	Lead Arsenate	D	0.03 ^b	68 ^e
	Grasshopper	140	Arsenicals	G	nd	nd
1939	Redheaded pine sawfly	1,388	Lead Arsenate	D	0.71 ^b	984 ^e
1940	Redheaded pine sawfly	1,404	Lead Arsenate	D	0.05 ^b	69 ^e
1945	Redheaded pine sawfly	1,935	DDT + water	D	nd	nd
1946	Redheaded pine sawfly	2,125	Lead Arsenate	D	nd	nd
	Redheaded pine sawfly	640	DDT + water	D	nd	nd
1947	Redheaded pine sawfly	1,233	DDT + oil ^d	D	nd	nd
1948	Redheaded pine sawfly	965	DDT + oil	D	nd	nd
	Saratoga spittlebug	480	DDT + oil	A	1	480
1949	Saratoga spittlebug	300	DDT + oil	B	nd	nd
	Grasshopper	30	Ammonium sulphate + sawdust	G	nd	nd
1950	Saratoga spittlebug	407	DDT + oil	A	1	407
	Jack pine budworm	320	DDT + oil	A	1	320
1951	Jack pine budworm	4,358	DDT + oil	A	1 ^d	4,358
1953	Saratoga spittlebug	1,028	DDT + oil	A	1	1,028
1954	Saratoga spittlebug	575	DDT + oil ^d	A	1	575
1955	Saratoga spittlebug	357	DDT + oil ^d	A ^d	1	357
1957	Redheaded pine sawfly	236	DDT + oil ^d	nd	nd	nd
	Saratoga spittlebug	436	DDT + oil ^d	A	1	436
1958	Redheaded pine sawfly	48	DDT + oil ^d	A	1	48
	Saratoga spittlebug	66	DDT + oil ^d	A	1	66
1959	Redheaded pine sawfly	47	DDT + oil ^d	D	nd	nd
	Saratoga spittlebug	324	DDT + oil ^d	A	1	324
1960	Redheaded pine sawfly	88	DDT + oil ^d	A	1	88
	Redheaded pine sawfly	10	DDT + oil ^d	D	nd	nd
	Saratoga spittlebug	706	DDT + oil ^d	A	1	706

Table F1.--Continued.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1961	White grub	364	Aldrin EC + water	E	0.20 ^b	73
	White grub	533	Aldrin EC + water	F	nd	nd
1962	Jack pine budworm	12,598	DDT + oil	A	1	12,598
	White grub	762	Aldrin EC + water	E	0.20 ^b	152
	White grub	376	Aldrin EC + water	E	0.21 ^b	79
	White grub	89	Aldrin EC + water	E	0.22 ^b	20
	White grub	456	Aldrin EC + water	E	0.31 ^b	141
	White grub	1,191	Aldrin EC + water	F	nd	nd
1963	White grub	105	Aldrin EC + water	E	0.21 ^b	22
	White grub	2,596	Aldrin EC + water	F	nd	nd
1964	White grub	76	Aldrin EC + water	E	0.18 ^b	14
1965	White grub	885	Aldrin EC + water	E	0.16 ^b	142
	White grub	342	Aldrin EC + water	D	0.18 ^b	62
1966	White grub	785	Aldrin EC + water	E	0.17 ^b	134
	White grub	259	Aldrin EC + water	D	0.17 ^b	44
	White grub	297	Aldrin EC + water	D	0.09 ^b	27
	White grub	80	Aldrin EC + water	E	0.11 ^b	9
	Red turpentine beetle	20	Lindane + oil	D	0.2 ^b	4
1967	White grub	552	Aldrin EC + water	E	0.19 ^b	105
	White grub	86	Aldrin EC + water	D	0.19 ^b	16
	White grub	140	Aldrin G	E	3.21 ^b	449
	White grub	2-E	Aldrin EC + water	E	0.11	0.2
	White grub	3-E	Aldrin EC + water	E	0.26	0.8
	White grub	1-E	Aldrin EC + water	D	0.09	0.1
	White grub	1-E	Aldrin EC + water	D	0.07	0.1
	White grub	3-E	Aldrin EC + water	D	0.16	0.5
	White grub	5-E	Aldrin G	E	3.21	16.0
1969	Redheaded pine sawfly	33	Malathion + water	D	0.09	3 ^e
	Saratoga spittlebug	90	Malathion C	A	0.75 ^b	68

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table F2.--Insecticidal control of Saratoga spittlebug in the Hiawatha National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre.	Total pounds ^b
Manistique	1948	480	DDT + oil	A	1	480
	1949	300	DDT + oil	B	nd ^c	nd
	1954	60	DDT + oil	A	1	60
	1955	220	DDT + oil ^d	A	1	220
	1959	200	DDT + oil ^d	A	1	200
	1960	640	DDT + oil ^d	A	1	640
Rapid River	1950	407	DDT + oil	A	1	407
	1953	1,028	DDT + oil	A	1	1,028
	1954	515	DDT + oil ^d	A	1	515
	1955	137	DDT + oil ^d	A ^d	1	137
	1957	436	DDT + oil ^d	A	1	436
	1958	66	DDT + oil ^d	nd	1	66
	1959	124	DDT + oil ^d	A	1	124
	1960	66	DDT + oil ^d	A	1	66
	1969	90	Malathion C	A	0.75 ^b	68

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table F3.--Insecticidal control of redheaded pine sawfly in the Hiawatha National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Manistique	1947	295	DDT + oil ^d	D	nd ^c	nd
	1948	190	DDT + oil	D	nd	nd
Munising	1945	1,935	DDT + water	D	nd	nd
	1946	640	DDT + water	D	nd	nd
	1947	709	DDT + oil	D	nd	nd
	1948	687	DDT + oil	D	nd	nd
Rapid River	1947	129	DDT + oil ^d	B	nd	nd
	1948	88	DDT + oil	D	nd	nd
	1957	236	DDT + oil ^d	nd	nd	nd
	1958	48	DDT + oil ^d	A	1	48
	1959	47	DDT + oil ^d	D	nd	nd
	1960	88	DDT + oil ^d	A	1	88
	1960	10	DDT + oil ^d	D	nd	nd
Sault Ste. Marie	1938	2,260	Lead Arsenate	D	0.03 ^b	68 ^e
St. Ignace	1936	454	Lead Arsenate	D	nd	nd
	1938	1,587	Lead Arsenate	D	nd	nd
	1939	1,388	Lead Arsenate	D	0.71 ^b	984 ^e
	1940	1,404	Lead Arsenate	D	0.05 ^b	69 ^e
	1946	2,125	Lead Arsenate	D	nd	nd
	1947	100	DDT + oil ^d	D	nd	nd
	1969	33	Malathion + water	D	0.09 ^b	3 ^e

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table F4.--Insecticidal control of white grub in the Hiawatha National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	Total pounds ^b
					Pounds per acre	
Manistique	1961	364	Aldrin EC + water	E	0.20 ^b	73
	1962	762	Aldrin EC + water	E	0.20 ^b	
	1962	118	Aldrin EC + water	F	nd ^c	152
	1963	105	Aldrin EC + water	E	0.21	22
	1963	669	Aldrin EC + water	F	nd	nd
	1964	76	Aldrin EC + water	E	0.18 ^b	14
	1966	297	Aldrin EC + water	D	0.09 ^b	27
	1966	80	Aldrin EC + water	E	0.11 ^b	9
	1967	1-E	Aldrin EC + water	E	0.11	0.1
	1967	1-E	Aldrin EC + water	D	0.09	0.1
	1967	1-E	Aldrin G	E	3.21	3.2
Munising	1961	533	Aldrin EC + water	F	nd	nd
	1962	376	Aldrin EC + water	E	0.21 ^b	
	1962	501	Aldrin EC + water	F	nd	nd
	1963	516	Aldrin EC + water	F	nd	nd
	1967	140	Aldrin G	E	3.21 ^b	449
	1967	1-E	Aldrin EC + water	E	0.11	0.1
	1967	1-E	Aldrin EC + water	D	0.07	0.1
	1967	1-E	Aldrin G	E	3.21	3.2
Rapid River	1962	89	Aldrin EC + water	E	0.22 ^b	20
	1962	27	Aldrin EC + water	F	nd	nd
	1963	158	Aldrin EC + water	F	nd	nd
Sault Ste. Marie	1962	456	Aldrin EC + water	E	0.31 ^b	141
	1962	460	Aldrin EC + water	F	nd	nd
	1963	1,253	Aldrin EC + water	F	nd	nd
	1965	885	Aldrin EC + water	E	0.16 ^b	142
	1965	342	Aldrin EC + water	D	0.18 ^b	62
	1966	785	Aldrin EC + water	E	0.17 ^b	134
	1966	259	Aldrin EC + water	D	0.17 ^b	44
	1967	552	Aldrin EC + water	E	0.19 ^b	105
	1967	86	Aldrin EC + water	D	0.19 ^b	16
	1967	3-E	Aldrin EC + water	E	0.26	0.8
	1967	3-E	Aldrin EC + water	D	0.16	0.5
	1967	3-E	Aldrin G	E	3.21	9.6
St. Ignace	1962	85	Aldrin EC + water	F	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

Table F5.--Insecticidal control of jack pine budworm, grasshopper, and red turpentine beetle in the Hiawatha National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Pounds per acre	Insecticide Total pounds ^b
<u>JACK PINE BUDWORM</u>						
Rapid River	1950	320	DDT + oil	A	1	320
	1951	4,358	DDT + oil	A	1 ^d	4,358
Sault Ste. Marie	1962	12,598	DDT + oil	A	1	12,598
<u>GRASSHOPPER</u>						
Manistique	1949	30	Ammonium sul-phate + sawdust	G	nd ^c	nd
Sault Ste. Marie	1938	140	Arsenicals	G	nd	nd
<u>RED TURPENTINE BEETLE</u>						
Rapid River	1966	20	Lindane + oil	D	0.2 ^b	4

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table G1.--Chronological summary of insecticide use in the Huron National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1961	Saratoga spittlebug	192	DDT + oil	A	1	192
1962	Saratoga spittlebug	680	DDT + oil	A	1	680
1963	Saratoga spittlebug	4,253	DDT + oil	A	1	4,253
1964	Saratoga spittlebug	4-E	DDT + oil	B	1	4
	Saratoga spittlebug	4-E	Malathion + Panasol AN-5	B	1	4
	Saratoga spittlebug	4-E	Malathion + Panasol AN-5	B	0.5	2
	Jack pine budworm	80-E	Malathion + Panasol AN-5	A	1	80
	Jack pine budworm	120-E	Malathion + Panasol AN-5	A	0.5	60
1965	Saratoga spittlebug	50-E	Malathion + Panasol AN-5	A	0.5	25
	Saratoga spittlebug	50-E	Malathion + Panasol AN-5	A	1	50
	Saratoga spittlebug	35-E	Malathion C	A	0.75	26
1966	Saratoga spittlebug	400	Malathion C	A	0.6	240
1969	Saratoga spittlebug	4,908	Malathion C	A	0.75	3,681

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table G2.--Insecticidal control of Saratoga spittlebug in the Huron National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	
					Total pounds ^b	
Harrisville	1961	192	DDT + oil	A	1	192
	1962	680	DDT + oil	A	1	680
	1963	4,253	DDT + oil	A	1	4,253
	1964	4-E	DDT + oil	B	1	4
	1964	4-E	Malathion + Panasol AN-5	B	1	4
	1964	4-E	Malathion + Panasol AN-5	B	0.5	2
	1969	4,810	Malathion C	A	0.75	3,608
Mio	1965	50-E	Malathion + Panasol AN-5	A	0.5	25
	1965	50-E	Malathion + Panasol AN-5	A	1	50
	1965	35-E	Malathion C	A	0.75	26
	1966	400	Malathion C	A	0.6	240
	1969	50	Malathion C	A	0.75	37
Tawas	1969	48	Malathion C	A	0.75	36

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table G3.--Insecticidal control of jack pine budworm in the Huron National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	
					Total pounds ^b	
Mio	1964	80-E	Malathion + Panasol AN-5	A	1	80
	1964	120-E	Malathion + Panasol AN-5	A	0.5	60

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

Table H1.--Chronological summary of insecticide use in the Manistee National Forest.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
1934	Redheaded pine sawfly	nd ^c	Lead Arsenate ^d	nd	nd	nd
1935	Redheaded pine sawfly	nd	Lead Arsenate ^d	nd	nd	nd
1936	Redheaded pine sawfly	nd	Lead Arsenate	C	nd	nd
	Grasshopper	18,293	Sodium Arsenate + bran	G	nd	nd
1937	Grasshopper	14,873	nd	G	nd	nd
1938	Redheaded pine sawfly	10,048	Lead Arsenate ^d	nd	nd	nd
	Grasshopper	2,945	nd	G ^d	nd	nd
1939	Redheaded pine sawfly	6,376	Lead Arsenate ^d	nd	nd	nd
	Redheaded pine sawfly & Jack pine sawfly	680	Nicotine Sulphate	nd	nd	nd
	Redheaded pine sawfly & Jack pine sawfly	300	Nicotine Sulphate & Lead Arsenate	nd	nd	nd
	Redheaded pine sawfly & Jack pine sawfly	4,260	Lead Arsenate	nd	nd	nd
	Grasshopper	400	Sodium Arsenate	G ^d	nd	nd
1940	Redheaded pine sawfly	177	Lead Arsenate ^d	C	nd	nd
	Grasshopper	10,288	nd	G ^d	nd	nd
1941	Grasshopper	1,677	nd	G ^d	nd	nd
1942	Grasshopper	nd	nd	G ^d	nd	nd
1946	Redheaded pine sawfly	1,800-E	DDT + oil	A	1.7	3,060
	Saratoga spittlebug	710-E	DDT + oil	A	1&2	nd
1947	Redheaded pine sawfly	3,224	DDT + oil	A	1	3,224
	Redheaded pine sawfly	25	DDT + water or oil	D	nd	nd
1948	Redheaded pine sawfly	300	DDT + kerosene	D	nd	nd
	Redheaded pine sawfly	2,240	DDT + oil	A	1	2,240
	Saratoga spittlebug	80	DDT + oil	A	1	80
	Grasshopper	415	Sodium Fluosilicate + sawdust	G	nd	nd
1949	Saratoga spittlebug	30-E	DDT + oil	B	0.5	15
	Saratoga spittlebug	64-E	DDT + oil	B	0.6 ^b	38
	Grasshopper	1,298	Chlordane + sawdust	G	0.15 ^b	195
1950	Saratoga spittlebug	195	DDT ^d + oil ^d	nd	nd	nd
	Saratoga spittlebug	124	DDT + oil	B	0.75	93

Table H1.--Continued.

Year	Insect species	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
1950	White pine weevil	80-E	DDT + oil	A	1	80
	White pine weevil	320-E	DDT + oil	A	2	640
1951	Saratoga spittlebug	310	DDT ^d + oil ^d	nd	nd	nd
	White pine weevil	nd	DDT + oil ^d	A	nd	nd
1952	European pine shootmoth	15 ^d	DDT ^d	B	nd	nd
1957	European pine shootmoth	84-E	DDT EC + water	C	7	588
1958	Redheaded pine sawfly	30	DDT + oil	D	nd	nd
	European pine shootmoth	53	DDT EC + water	B	7	371
	European pine shootmoth	150	DDT EC + water	B	10	1,500
1959	Saratoga spittlebug	134	DDT + oil	A	1	134
1960	Redheaded pine sawfly	202	Malathion	A	2	404 ^e
	European pine shootmoth	404	Malathion	A	2	808
	European pine shootmoth	14	Naled + water	nd	nd	nd
1962	European pine shootmoth	10-E	DDT	C	2	20
	European pine shootmoth	4-E	DDT	B	2	8
	European pine shootmoth	3-E	DDT	B	4.5	14
1964	Jack pine budworm	60-E	Malathion + Panasol AN-5	A	0.5	30
	Jack pine budworm	60-E	Malathion + Panasol AN-5	A	1	60
	Jack pine budworm	60-E	DDT + oil	A	1	60
	Jack pine budworm	15-E	Zectran EC + water	A	1	15
	Jack pine budworm	15-E	Dimethoate EC + water	A	0.5	8
1966	Jack pine budworm	200-E	Malathion C	A	1 ^b	200
1969	Redheaded pine sawfly	50-E	Malathion + water	C	1	50 ^e
1970	Redheaded pine sawfly	45-E	Malathion C	A	0.75 ^b	34 ^e

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table H2.--Insecticidal control of redheaded pine sawfly in the Manistee National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide	
					Pounds per acre	Total pounds ^b
Baldwin	1939	680	Nicotine Sulphate	nd ^c	nd	nd
	1939	300	Nicotine Sulphate + Lead Arsenate	nd	nd	nd
	1939	4,260	Lead Arsenate	nd	nd	nd
	1958	30	DDT + oil	D	nd	nd
Cadillac	1934	nd	Lead Arsenated ^d	nd	nd	nd
	1935	nd	Lead Arsenated ^d	nd	nd	nd
	1936	nd	Lead Arsenate	C	nd	nd
	1938	3,048	Lead Arsenate	nd	nd	nd
	1939	1,698	Lead Arsenate	nd	nd	nd
	1947	1,185	DDT + oil	A	1	1,185
	1947	25	DDT + water or oil	D	nd	nd
	1948	460	DDT + oil	A	1	460
	1948	300	DDT + kerosene	D	nd	nd
	1960	202	Malathion	A	2	404 ^e
Manistee	1969	50-E	Malathion + water	C	1	50 ^e
	1970	45-E	Malathion C	A	0.75 ^b	34 ^e
	1938	7,000	Lead Arsenated ^d	nd	nd	nd
	1939	4,678	Lead Arsenated ^d	nd	nd	nd
	1940	177	Lead Arsenated ^d	C	nd	nd
Unknown	1947	2,039	DDT + oil	A	1	2,039
	1948	1,780	DDT + oil	A	1	1,780
Unknown	1946	1,800-E	DDT + oil	A	1.7	3,060

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

^ePounds of insecticide used were reported.

Table H3.--Insecticidal control of Saratoga spittlebug in the Manistee National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Baldwin	1946	710-E	DDT + oil	A	1&2	nd ^c
	1948	40	DDT + oil	A	1	40
	1949	42-E	DDT + oil	B	0.6 ^b	25
	1950	20	DDT ^d + oil ^d	nd	nd	nd
	1951	268	DDT ^d + oil ^d	nd	nd	nd
Cadillac	1948	40	DDT + oil	A	1	40
	1949	22-E	DDT + oil	B	0.6 ^b	13
	1950	115	DDT ^d + oil ^d	nd	nd	nd
Manistee	1949	30-E	DDT + oil	B	0.5	15
	1950	124	DDT + oil	B	0.75	93
White Cloud	1950	60	DDT ^d + oil ^d	nd	nd	nd
	1951	42	DDT ^d + oil ^d	nd	nd	nd
	1959	134	DDT + oil	A	1	134

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table H4.--Insecticidal control of European pine shootmoth in the Manistee National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Cadillac	1952	15 ^d	DDT ^d	B	nd ^c	nd
	1957	84-E	DDT EC + water	C	7	588
	1958	53	DDT EC + water	B	7	371
	1958	150	DDT EC + water	B	10	1,500
	1960	404	Malathion	nd	2	808
White Cloud	1960	14	Naled + water	nd	nd	nd
	1962	10-E	DDT	C	2	20
	1962	4-E	DDT	B	2	8
	1962	3-E	DDT	B	4.5	14

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

Table H5.--Insecticidal control of jack pine budworm, white pine weevil, and jack pine sawfly in the Manistee National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
<u>JACK PINE BUDWORM</u>						
Baldwin	1964	60-E	DDT + oil	A	1	60
	1964	60-E	Malathion + Panasol AN-5	A	0.5	30
	1964	60-E	Malathion + Panasol AN-5	A	1	60
	1964	15-E	Zectran EC + water	A	1	15
	1964	15-E	Dimethoate EC + water	A	0.5	8
Cadillac	1966	200-E	Malathion C	A	1 ^b	200
<u>WHITE PINE WEEVIL</u>						
Cadillac	1950	80-E	DDT + oil	A	1	80
	1950	320-E	DDT + oil	A	2	640
	1951	nd ^c	DDT + oil ^d	A	nd	nd
<u>JACK PINE SAWFLY</u>						
Baldwin	1939	680	Nicotine Sulphate	nd	nd	nd
	1939	300	Nicotine Sulphate + Lead Arsenate	nd	nd	nd
	1939	4,260	Lead Arsenate	nd	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cnd: no data available as source documents were incomplete.

^dInference: see page 15.

Table H6.--Insecticidal control of grasshopper in the Manistee National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Appli-cation method ^a	Insecticide Pounds per acre	Total pounds ^b
Baldwin	1939	400	Sodium Arsenate	G ^d	nd ^c	nd
	1942	nd	nd	G ^d	nd	nd
Cadillac	1936	18,293	Sodium Arsenate + bran	G	nd	nd
	1937	14,873	nd	G	nd	nd
	1938	2,825	nd	G ^d	nd	nd
	1948	415	Sodium Fluosilicate + sawdust	G	nd	nd
	1949	1,298	Chlordane + sawdust	G	0.15 ^b	195
Manistee	1938	120	nd	G ^d	nd	nd
Unknown	1940	10,288	nd	G ^d	nd	nd
	1941	1,677	nd	G ^d	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

^dInference: see page 15.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NA S&PF
St. Paul Field Office

REPLY TO: 5200

August 3, 1973

SUBJECT: ERRATA for report S-72-8, April, 1973
"Insecticide Use in the National Forests of the
Lake States: A History" by Richard F. Fowler

TO:
Recipients of above report



Additional documents have been found necessitating the issuance of an errata sheet. We suggest that you make pen and ink changes in your copy of the report. Table 1 (page 3) has been retyped and the new Table may be pasted over the current Table.

Changes were made relating to redheaded pine sawfly, Saratoga spittlebug, forest tent caterpillar, and European pine shootmoth. The insecticides involved were DDT and, in one case, an unnamed chemical.

Please don't hesitate to contact us regarding any questions or errors.

HARVEY V. TOKO
Field Representative
Forest Pest Management

Enclosure

ERRATA

Insecticide Use in the National Forests of the Lake States: A History
by Richard F. Fowler
Report No. S-72-8

April, 1973

Abstract

Line 5 change 5.3 to 5.4

List of Tables

Page iv add:

G4. Insecticidal control of redheaded pine sawfly in the Huron
National Forest by ranger districts 44

Page 3 Table 1

(New table supplied--This Table should be pasted over the existing
Table.)

Page 4

Line 1. Change 367,593+ to 374,250+
Line 3. Change 359,134+ to 364,991+
Line 4. Change 8,459+ to 9,259+
Line 6. Change 5.3+ to 5.4+

Page 8 Table 2

Under Redheaded pine sawfly DDT:
Change 23,809+ to 25,581+ and 12,814+ to 13,795+

Under Saratoga Spittlebug DDT:
Change 85,263 to 89,540 and 83,642+ to 87,716+

Under Forest Tent Caterpillar DDT:
Add 1952 (1951-1952) and change 664 to 1,183 in both cases

Under European pine shootmoth DDT:
Change 319 to 408

Page 11

Line 1. Change 264,462+ to 271,030+ and 250,710+ to 257,014+

Changes are needed in the Appendix Tables. The corrected entries are listed
below by giving the entire entry. New entries are added and a few deleted.

Page 18, Table Al.

Add:

1952 Forest tent caterpillar	519	DDT + oil	A	1	519
1953 Redheaded pine sawfly	50	DDT + oil	D	nd	nd

Page 23, Table Cl.

1946 Redheaded pine sawfly	300	DDT + water	D	nd	nd
1950 Redheaded pine sawfly	748	DDT + oil	D	nd	nd
Redheaded pine sawfly	35	DDT + oil	B	nd	nd

Page 2 ERRATA

1952 Saratoga spittlebug	618	DDT + oil	A	1 ^d	618
Saratoga spittlebug	200	DDT + oil	B	nd	nd
1953 Saratoga spittlebug	1,921	DDT + oil	A	1	1,921
1956 Saratoga spittlebug	773	DDT + oil	A	1	773
1957 Saratoga spittlebug	544	DDT + oil	A	1	544
1958 Saratoga spittlebug	755	DDT + oil	A	1	755

Page 27, Table Dl.

1950 Saratoga spittlebug	8,770	DDT + oil	A	1	8,770
1952 Saratoga spittlebug	1,743	DDT + oil ^d	A	1	1,743
1953 Saratoga spittlebug	6,014	DDT + oil	A	1	6,014
1954 Saratoga spittlebug	2,850	DDT + oil	A	1	2,850
1955 Saratoga spittlebug	5,538	DDT + oil	A	1	5,538
1956 Saratoga spittlebug	2,097	DDT + oil	A	1	2,097
1957 Saratoga spittlebug	4,710	DDT + oil	A	1	4,710

Page 28, Table Dl (cont.).

1958 Redheaded pine sawfly	21	DDT + water	D	nd	nd
Redheaded pine sawfly	20	DDT + oil	A	1	20
Saratoga spittlebug	3,194	DDT + oil	A	1	3,194

Page 34, Table El.

1950 Saratoga spittlebug	440	DDT + oil	A	1.05 ^b	460 ^e
Saratoga spittlebug	5-E	DDT + water	D	2	10 ^e
1951 Saratoga spittlebug	1,200	DDT + oil	A	1 ^d	1,200
1952 Saratoga spittlebug	1,100	DDT + oil	A	1	1,100
1953 Saratoga spittlebug	2,168	DDT + oil	A	1	2,168
1954 Saratoga spittlebug	1,227	DDT + oil	A	1	1,227
Saratoga spittlebug	13	DDT + water	D	nd	nd
1955 Saratoga spittlebug	1,570	DDT + oil	A	1	1,570
1956 Saratoga spittlebug	212	DDT + oil	A	1	212
1962 Saratoga spittlebug	30	DDT	nd	0.96 ^b	29 ^e

Page 3 ERRATA

Page 37, Table Fl.

1948	Redheaded pine sawfly	965	DDT + oil	D	1	965
1954	Saratoga spittlebug	575	DDT + oil	A	1	575
1955	Saratoga spittlebug	357	DDT + oil ^d	A	1	357
1957	Redheaded pine sawfly	236	DDT + oil ^d	D	nd	nd
	Saratoga spittlebug	633	DDT + oil	A	1	633
1958	Redheaded pine sawfly	54	DDT + oil	A	1	54
	Saratoga spittlebug	66	DDT + oil	A	1	66

Page 43, Table Gl.

1935	Redheaded pine sawfly	nd ^c	nd	nd	nd	nd
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At bottom of page, add:

^cNd: No data available as source documents were incomplete.

Page 45, Table Hl.

1946	Redheaded pine sawfly	800-E	DDT + oil	D	nd	nd
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Page 46, Table Hl (cont.).

1951	Saratoga spittlebug	310	DDT + oil	B&D	nd	nd
	Redheaded pine sawfly	12	DDT ^d + oil ^d	nd	nd	nd
1952	European pine shootmoth	104	DDT + water	B	nd	nd
	Saratoga spittlebug	215	DDT ^d + oil ^d	B	nd	nd
1959	Saratoga spittlebug	134	DDT + oil	A	1	134

Page 19, Table A2.

Under REDHEADED PINE SAWFLY, add:

Unknown	1953	50	DDT + oil	D	nd	nd
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Under FOREST TENT CATERPILLAR, add:

Unknown	1952	519	DDT + oil	A	1	519
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Page 25, Table C3.

Glidden	1950	35	DDT + oil	B	nd ^c	nd
Hayward	1950	748	DDT + oil	D	nd	nd
Park Falls	1946	300	DDT + water	D	nd	nd

Page 26, Table C4.

Park Falls	1953	1,921	DDT + oil	A	1	1,921
	1958	695	DDT + oil	A	1	695
Unknown	1952	618	DDT + oil	A	1 ^d	618
	1952	200	DDT + oil	B	nd	nd
	1956	64	DDT + oil	A	1	64
	1957	55	DDT + oil	A	1	55

Page 29, Table D2.

Eagle River	1952.	Delete entire entry.				
	1953	585	DDT + oil	A	1	585
	1955	1,465	DDT + oil	A	1	1,465
Florence	1953	790	DDT + oil	A	1	790
	1955	414	DDT + oil	A	1	414
Lakewood	1952	1,198	DDT + oil	A	1	1,198
	1953	1,412	DDT + oil	A	1	1,412
	1954	1,393	DDT + oil	A	1	1,393

Page 30, Table D2.--(Cont.)

Laona	1953	940	DDT + oil	A	1	940
	1954	792	DDT + oil	A	1	792
Three Lakes	1952	545	DDT + oil ^d	A	1	545

Page 30, Table D2.--(Cont.)

Three Lakes	1953	2,287	DDT + oil	A	1	2,287
	1954	50	DDT + oil	A	1	50
	1955	148	DDT + oil	A	1	148

Page 31, Table D2.--(Cont.)

Unknown	1956	84	DDT + oil	A	1	84
	1957	82	DDT + oil	A	1	82
	1958	130	DDT + oil	A	1	130

Page 31, Table D3.

Eagle River ^d	1958	20	DDT + oil	A	1	20
	1958	21	DDT + water	D	nd	nd

Page 32, Table D4.

Under PINE TORTOISE SCALE:

Lakewood	1954	25-E	DDT EC + water	A	2	50
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Page 35, Table E2.

Bessemer	1952	550	DDT + oil	A	1	550
	1955	142	DDT + oil	A	1	142

Kenton	1952	550	DDT + oil	A	1	550
	1955	887	DDT + oil	A	1	887

Ontonagon	1955	114	DDT + oil	A	1	114
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Watersmeet 1950. Delete entry 60 DDT + oil etc.

1952. Delete entire entry.

	1953	500	DDT + oil	A	1	500
	1955	427	DDT + oil	A	1	427
	1962	30	DDT	nd	0.96 ^b	29 ^e

Unknown	1953	588	DDT + oil	A	1	588
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Page 39, Table F2.

Rapid River	1954	515	DDT + oil	A	1	515
	1955	137	DDT + oil ^d	A	1	137
	1957	633	DDT + oil	A	1	633
	1958	66	DDT + oil	nd	1	66

Page 40, Table F3.

Manistique	1948	190	DDT + oil	D	1	190
Munising	1948	687	DDT + oil	D	1	687
Rapid River	1948	88	DDT + oil	D	1	88
	1957	236	DDT + oil	D	nd	nd
	1958	54	DDT + oil	A	1	54

Page 44, Table G4.--Insert Table G4 below, following Table G3.

Table G4.--Insecticidal control of redheaded pine sawfly in the Huron National Forest by ranger districts.

Ranger district	Year	Acres treated	Insecticide and carrier	Application method ^a	Pounds per acre	Insecticide Total pounds ^b
Unknown	1935	nd ^c	nd	nd	nd	nd

^aA=aerial; B=mist-blower; C=hydraulic sprayer; D=hand sprayer; E=planting machine; F=hand dipped planting stock; G=broadcast on ground surface.

^bCalculated: see page 15.

^cNd: no data available as source documents were incomplete.

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Unknown	1946	800-E	DDT + oil	D	nd	nd
Unknown	1951	12	DDT ^d + oil ^d	nd	nd	nd

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Baldwin	1951	268	DDT + oil	B&D	nd	nd
	1952	215	DDT ^d + oil ^d	B	nd	nd
White Cloud	1951	42	DDT + oil	B&D	nd	nd

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Cadillac	1952	104	DDT + water	B	nd ^c	nd
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Table 1.--Gross and federally-owned Lake States national forests acreages and acres treated with insecticides, 1934-1971.

National Forest	State located	Year established ^a	Acres ^b		Federal acres treated ^c			
			Gross	Federal	Project	Experiment	Total	Percent
Chippewa	Minn.	1923	1,314,322	649,978	27,559+	180	27,739+	4.3+
Superior	Minn.	1909	3,022,657	2,055,018	84,936	570+	85,506+	4.2+
Chequamegon	Wisc.	1936	1,030,993	839,055	47,373+	1,000	48,373+	5.8+
Nicolet	Wisc.	1933	942,008	650,346	55,949+	2,425	58,374+	9.0+
Ottawa	Mich.	1931	1,522,540	915,377	12,030	312	12,342	1.3
Hiawatha	Mich.	1909 ^d	1,260,411	861,084	46,865	15	46,880	5.4
Huron	Mich.	1909	691,444	418,844	10,433+	347	10,780+	2.6+
Manistee	Mich.	1938	1,314,904	488,197	79,846+	4,410	84,256+	17.2+
Total			11,099,279	6,877,899	364,991+	9,259+	374,250+	5.4+

^aSome forests existed earlier as purchase units; this is proclamation date as a National Forest.^bForest acreages as of June 30, 1972.^cThe plus (+) sign represents incompletely documented additional treated acreage.^dEast Unit proclaimed Marquette N.F. in 1909; West Unit proclaimed Hiawatha N.F. in 1931. The Forests were combined in 1962.

(Paste this Table 1 over Table 1 found on page 3)